Deber 1

Santiago Reinoso 15 - 11 - 21

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1 a) ≈ 4.66 b) ≈ 55.6 s c) 4.56×10^3 d) 2.77×10^3

4 a) $\frac{Mg}{ms} = \frac{Gg}{s}$ b) $\frac{N}{mm} = \frac{KN}{m}$ c) $\frac{mN}{Kg \cdot \mu s} = \frac{KN}{Kg \cdot s}$

7

$m = 250 (10)^3$ slugs

a) Su masa en SI

1 slug = 14.59 Kg

$m_t = 250 (10)^3 \left(14.59 \text{ Kg} \right) = 3.65 \text{ Gg}$

b) $W_t = m_t \cdot g_t = (3.65 \text{ Gg})(9.81 \text{ m/s}^2) = 35.8 \text{ MN}$

c) $W_L = m_L \cdot g_L = (3.56 \times 10^6 \text{ g})(g_L)$ 1m = 3.28 pies

$g_L = 5.30 \frac{\text{pies}}{s^2} \cdot \frac{1m}{3.28 \text{ pies}} = 1.62 \text{ m/s}^2$

$W_L = (3.56 \times 10^6 \text{ g})(1.62 \text{ m/s}^2) = 5.90 \times 10^6 \text{ N} = 5.90 \text{ MN}$

d) $m_L = 3.65 \text{ Gg}$ = es la misma que en la tierra

$m_t = m_L$

10 a) 10 Kg $\rightarrow$ $w = mg = (10)(9.81) = 98.1$ N

b) $0.5 \text{ gr} = 0.50 \times 10^{-3} \rightarrow w = (0.5 \times 10^{-3})(9.81) = 4.90 \times 10^{-3}$ N

c) $4.50 \text{ Mg} = 4500 \text{ Kg} \rightarrow w = (450 \times 10^3)(9.81) = 44.1 \times 10^3$ N

13 a) 20 lb · pie a N · m

$20 \text{ lb} \cdot \text{pie} \left(\frac{4.448 \text{ N}}{1 \text{ lb}} \right) \left(\frac{1 \text{ m}}{3.28 \text{ pie}} \right) = 27.122 \text{ N} \cdot \text{m}$

b) $450 \frac{\text{lb}}{\text{pie}^3}$ a $\frac{KN}{m^3}$

$450 \frac{\text{lb}}{\text{pie}^3} \cdot \left(\frac{4.448 \text{ N}}{1 \text{ lb}} \right) \left(\frac{3.28 \text{ pies}}{1 \text{ m}} \right)^3 \left(\frac{1 \text{ KN}}{1000 \text{ N}} \right)$

ESTILO

$= 70.63 \ \frac{kN}{m^3}$

c) $15 \ \frac{pies}{h}$ a $\frac{mm}{s}$

$$15 \ \frac{pies}{h} \left(\frac{1m}{3.28 \ pies} \right) \left(\frac{1h}{3600 \ s} \right) \left(\frac{1000 \ mm}{1m} \right) = 1.27 \ \frac{mm}{s}$$

16 $m_1 = 8 \ kg$

$m_2 = 12 \ kg$

$d = 800 \ mm = 0.8 \ m$

$G = 6.674 \times 10^{-11} \ N.m^2 / kg^2$

$$F = G . \frac{m_1 . m_2}{d^2}$$

$$F = 6.674 \times 10^{-11} \left(\frac{(8)(12)}{(0.8)^2} \right) = 10 \times 10^{-9} \ N = 10 \ nN$$

$W_1 = m_1 g = 8(9.81) = 78.48 \ N$

$W_2 = m_2 . g = 12 \ (9.81) = 117.72 \ N$

18 a) $(200 \ kN)^2 = 40000 \times 10^6 \ N^2 = 400 \times 10^8 \ N^2$

b) $(0.005 \ mm)^2 = 2.5 \times 10^{-5} \times 10^{-6} \ m^2 = 2.50 \times 10^{-11} \ m^2$

c) $(400 \ m)^3 = 640 \times 10^5 \ m^3$

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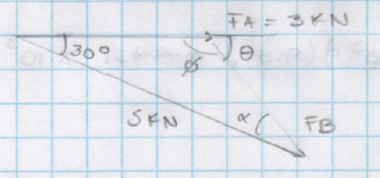
2 - 8



Ley de cosenos

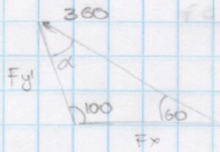
$$F_B = \sqrt{3^2 + 5^2 - 30 \cos 30} = 2.832 \ KN$$

Ley de senos

$$\frac{2.832}{\operatorname{sen} 30} = \frac{3}{\operatorname{sen} \alpha} \Rightarrow \alpha = 32°$$

$$\theta = 30 + \alpha = 62°$$

2-12



Ley de senos

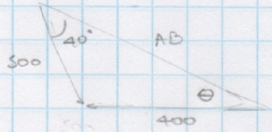
$$\frac{360}{\text{sen } 100} = \frac{Fy'}{\text{sen } 60} \Rightarrow Fy' = 316.6 \text{ N}$$

Ley de cosenos

$$Fx = \sqrt{(360)^2 + (316.6)^2 - 2(360)(316.6)\cos(20)}$$

$$Fx = 125 \text{ N}$$

2-14



Ley de senos

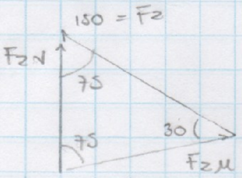
$$\frac{500}{\text{sen } \theta} = \frac{400}{\text{sen } 40} \quad \theta = 53.5^\circ$$

Ley de cosenos

$$AB = \sqrt{500^2 + 400^2 - 2(500)(400)\cos 86.5}$$

$$AB = 621.15 \text{ lb}$$

2-17



LdS $\frac{150}{\text{sen } 75} = \frac{Fz\,V}{\text{sen } 30} \Rightarrow Fz\,V = 77.64 \text{ N}$

$$\frac{150}{\text{sen } 75} = \frac{Fz\,u}{\text{sen } 75} \Rightarrow Fz\,u = 150$$

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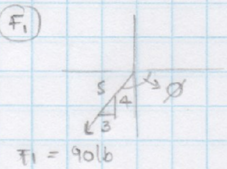
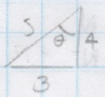
F 2-11

(F1)





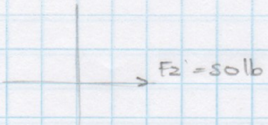
$$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 36.87^\circ$$

$$\phi = 90 + \theta = 126.87^\circ$$

$$F1x = 90 \cos(-126) = -52.9$$

$$F1y = 90 \text{ sen } 126 = -72.81$$

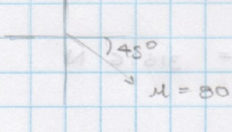
(F2)



$$F2x = 50 \text{ lb}$$

$$F2y = 0$$

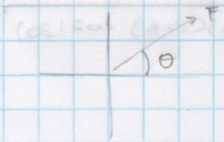
(μ)



$\mu_x = 80 \cos -45 = 56.57$

$\mu_y = 80 \text{ sen } -45 = -56.57$

(F)



$F_x = F \cos \theta$

$F_y = F \text{ sen}\theta$

$\Sigma F_x = 56.57$

$F \cos \theta - 52.9 + 50 = 56.57$

① $F \cos \theta = 59.47$

$\Sigma F_y = -56.57$

$-72.81 + F \text{sen}\theta = -56.57$

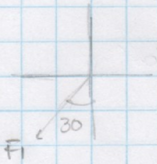
② $F \text{ sen}\theta = 16.24$

resolviendo

$F = 62.503$ lb $\qquad \theta = 14.3°$

2-38

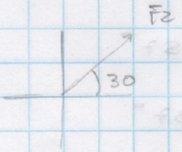
(F1)



$F_{1x} = 4 \cos 120 = -2$ N

$F_{1y} = 4 \text{ sen } 60 = -3.46$ N

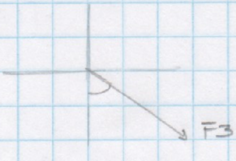
(F2)



$F_{2x} = F_2 \cos 30$ N

$F_{2y} = F_2 \text{ sen } 30$ N

(F3)



$F_{3x} = 5 \cos(-36.87) = 4$ N

$F_{3y} = 5 \text{ sen } (-36.87) = -3$ N

$\Sigma f_y = 0$

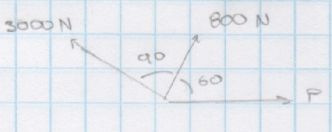
$-3.46 + F_2 \text{ sen } 30 - 3 = 0$

$F_2 = \dfrac{6.46}{\text{sen } 30} = 12.92 \text{ N}$

$\Sigma f_x = F_R$

$-2 + 12.92 \cos 30 + 4 = F_R \Rightarrow F_R = 13.19$

2 - 50



$\Sigma f_x = F_{R_x}$

$3000 \cos(150) + 800 \cos 60 + P = F_{Rx}$

$F_{Rx} = P - 2198.1$

$\Sigma f_y = F_{Ry}$

$3000 \text{ sen } 150 + 800 \text{ sen } 60 = F_{Ry}$

$F_{Ry} = 2192.82 \text{ N}$

$F_R = \sqrt{(F_{Rx})^2 + (F_{Ry})^2}$

$F_R = \sqrt{(P - 2198.1)^2 + (2192.82)^2} \le 2400$

$(P - 2198.1)^2 + (2192.82)^2 \le (2400)^2$

$(P - 2198.1)^2 \le (2400)^2 - (2192.82)^2$

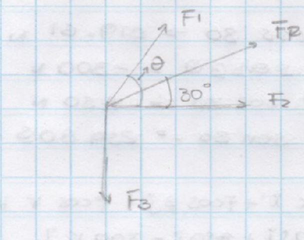
$P - 2198.1 \le \sqrt{951.540.45 \text{ N}^2}$

$|P - 2198.1| \le 975.5 \text{ N}$

$-975.5 \text{ N} \le P - 2198.1 \le 975.5 \text{ N}$

$1222.6 \text{ N} \le P \le 3173.6$

2 - 58



$\Sigma f_x = F_R \cos 30$

$F_1 \cos\theta + F_2 = F_R \cos 30$

$F_1 \cos\theta + 350 = 519.61$

$F_1 \cos\theta = 169.61$

$\Sigma f_y = F_R \text{ sen } 30$

$F_1 \text{ sen } \theta = F_R \text{ sen } 30 + F_3$

$F_1 \text{ sen } \theta = 400$

$F_1 = \dfrac{169.61}{\cos\theta} \longrightarrow 169.61 \dfrac{\text{sen}\theta}{\cos\theta} = 400$

$\theta = \tan^{-1}\left(\dfrac{400}{169.61}\right) = 67°$

$F_1 = 434.85 \text{ N}$

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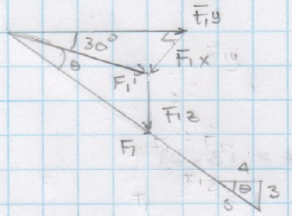
2-72

(F1)



$\theta = \tan^{-1}\left(\frac{3}{4}\right) = 36.87$

$F_{1z} = F_1 \cos\theta$

$F_{1z} = 600 \quad sen(36.87) = -360$ lb

$F_1' = 600 \cos(36.87) = 480$ lb

$F_{1y} = F_1' \cos 30 = 416$ lb

$F_{1x} = F_1' \ sen\ 30 = 240$ lb

$F_1 = [240\,i + 416\,j - 360\,k]$

$F_R = [-200\,i + 800\,j + 150\,k]$

$F = [F\cos\alpha\, i + F\cos\beta + F\cos\gamma]$

$F = F_R - F_1$

$F_x = -200 - 240$ $\qquad$ $F_y = 800 - 416$ $\qquad$ $F_z = 150 + 360$

$F\cos\alpha = -440$ lb $\qquad$ $F\cos\beta = 384$ lb $\qquad$ $F\cos\gamma = 510$

$F^2\cos^2\alpha = (-440)^2$ $\qquad$ $F^2\cos^2\beta = (348)^2$ $\qquad$ $F^2\cos^2\gamma = (510)^2$

$F^2(\cos^2\alpha + \cos^2\beta + \cos^2\gamma) = 601156\ lb^2$

$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1$

$F^2 = 601156$ $\qquad$ $F = 775.34$ lb

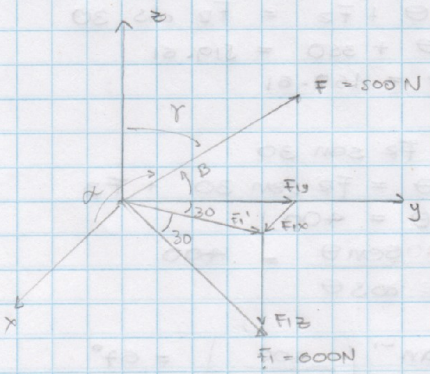
remplazando

$\alpha = 125°$

$\beta = 60.31°$

$\gamma = 4°$

2-78



$F_1' = F_1 \cos 30 = 519.61$ N

$F_{1z} = F_1 \ sen\ 30 = -300$ N

$F_{1y} = F_1' \cos 30 = 450$ N

$F_{1x} = F_1' \ sen\ 30 = 259.805$ N

$F = [F\cos\alpha\, i + F\cos\beta\, j + F\cos\gamma\, k]$

$F_1 = [259.805\,i + 450\,j - 300\,k]$

$F_R = [0\,i + F_{Ry}\,j + 0\,k]$

$\cos\alpha = \frac{F_{1x}}{F} \Rightarrow \alpha = 121.31°$

$\cos\gamma = \frac{F_{1z}}{F} \Rightarrow \gamma = 53.13°$

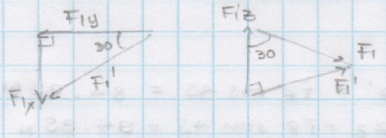
$\cos^2\alpha + \cos^2\beta + \cos^2\gamma = 1 \Rightarrow \beta = 52.5°$

$\Sigma f_y = F_R$

$F_R = 500 \cos\beta + 450 = 754\ N$

2 - 80

(F1)



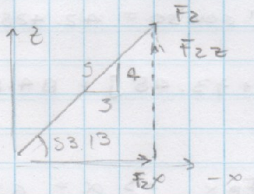
$F_1' = F_1 \cos 60 = 5\ KN$

$F_{1z} = F_1 \text{ sen } 60 = 8.66\ KN$

$F_{1y} = F_1' \cos 30 = 4.33\ KN$

$F_{1x} = F_1' \text{ sen } 30 = 2.5\ KN$

(F2)

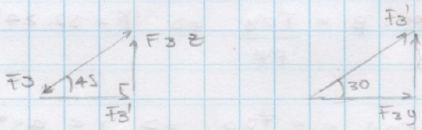


$F_{2x} = F_2 \cos 53.13 = 4.8\ KN$

$F_{2y} = 0$

$F_{2z} = F_2 \text{ sen } 53.13 = 6.4\ KN$

(F3)



$F_3' = F_3 \cos 45 = 6.364\ KN$

$F_{3z} = F_3 \text{ sen } 45 = 6.364\ KN$

$F_{3y} = F_3' \cos 30 = 5.51\ KN$

$F_{3x} = F_3' \text{ sen } 30 = 3.182\ KN$

$F_1 = [-2.5 i + 4.33 j - 8.66 k]\ KN$

$F_2 = [-4.8 i + 0 j + 6.4 k]\ KN$

$F_3 = [3.182 i - 5.51 j - 6.364]\ KN$

$F_R = \Sigma F$

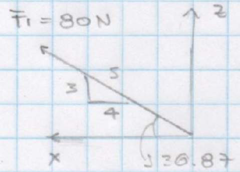
$F_R = [-4.118 i - 1.18 j - 8.624 k]\ KN$

$|F_R| = 9.63\ KN$

$\cos\alpha = \frac{F_{Rx}}{F_R}$ $\quad \cos\beta = \frac{F_{Ry}}{F_R}$ $\quad \cos\gamma = \frac{F_{Rz}}{F_R}$

$\alpha = 115°$ $\quad \beta = 97°$ $\quad \gamma = 154°$

2-84



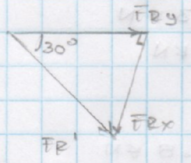
$F_{1x} = 80 \cos 36.87 = 64 N$

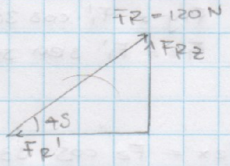
$F_{1y} = 0$

$F_{1z} = 80 \operatorname{sen} 36.87 = 48 N$

$F_1 = [64 i + 0 j + 48 k] N$

$|F_1| = 80 N$





$F_R' = F_R \cos 45 = 84.85 N$

$F_{Rz} = F_R \operatorname{sen} 45 = 84.85 N$

$F_{Ry} = F_R' \cos 30 = 73.48 N$

$F_{Rx} = F_R' \operatorname{sen} 30 = 42.425 N$

$F_R = [42.425 i + 73.48 j + 84.85 k] N$

$|F_R| = 120 N$

$\cos \alpha = \frac{F_{1x}}{F_1} \Rightarrow \alpha = 36.87°$

$\cos \beta = \frac{F_{1y}}{F_1} \Rightarrow \beta = 90°$

$\cos \gamma = \frac{F_{1z}}{F_1} \Rightarrow \gamma = 53.13°$

$\cos \alpha = \frac{F_{Rx}}{F_R} \Rightarrow \alpha = 69.3°$

$\cos \beta = \frac{F_{Ry}}{F_R} \Rightarrow \beta = 52.24°$

$\cos \gamma = \frac{F_{Rz}}{F_R} \Rightarrow \gamma = 45°$

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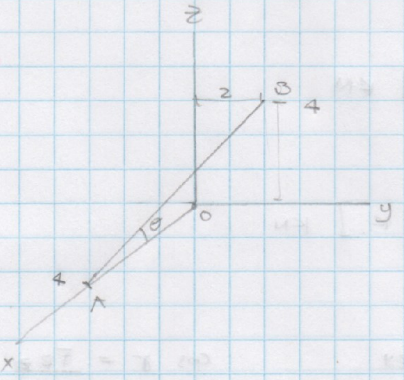
F2-20.



A (4, 0, 0)   B (0, 2, 4)

AB = B − A = (−4, 2, 4) ft
vector posición

$l = |AB| = \sqrt{(4)^2 + (-4)^2 + (2)}$
$= \sqrt{36} = 6$

$\cos \alpha = \frac{AB_x}{|AB|} = -\frac{2}{3}$

$\alpha = 131.81°$

$\theta = 180 - \alpha = 48.19°$

F2-24

A (2, 0, 6) B (0, 4, 2) C (−4, 3, 4)

$AC = (-6, 3, -2)$

$|AC| = \sqrt{49} = 7$

$\hat{AC} = \frac{-6}{7} i + \frac{3}{7} j - \frac{2}{7} K$

$\bar{F}_{AC} = \bar{F}_C \cdot \hat{AC} = -420 i + 210 j - 140 K$

$AB = (-2, 4, -4)$

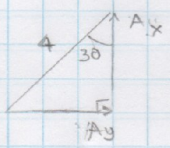
$|AB| = \sqrt{36} = 6$

$\hat{AB} = -\frac{2}{6} i + \frac{4}{6} j - \frac{4}{6} K$

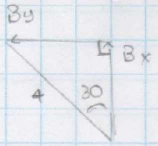
$\bar{F}_{AB} = \bar{F}_B \cdot \hat{AB} = (-200 i + 400 j - 400 K)$ lb

$\bar{F}_{RA} = (-620 i + 610 j - 540 K)$ lb

2-94



$A_x = 4 \cos 30 = 3.5$ pies
$A_y = 4 \text{ sen } 30 = 2$ pies
A (3.5, −2, 0)



$B_x = 4 \cos 30 = 3.5$ pies
$B_y = 4 \text{ sen } 30 = 2$ pies
B (−3.5, −2, 0)

C (0, 4, 0)

O (0, 0, 6)

$OA = (3.5, -2, -6)$ $|OA| = 7.23$ $\hat{OA} = 0.48 i - 0.28 j - 0.83 K$

$OB = (-3.5, -2, -6)$ $|OB| = 7.23$ $\hat{OB} = -0.48 i - 0.28 j - 0.83 K$

$OC = (0, 4, -6)$ $|OC| = \sqrt{52}$ $\hat{OC} = 0.55 j - 0.83 K$

$\vec{F_A} = F_A \cdot \hat{OA} = 0.48\, F_A i - 0.28\, F_A j - 0.83\, F_A k$

$\vec{F_B} = F_B \cdot \hat{OB} = -0.48\, F_B i - 0.28\, F_B j - 0.83\, F_B k$

$\vec{F_C} = F_C \cdot \hat{OC} = 0 i + 0.55\, F_C j - 0.83\, F_C k$

$F_R = 0 i + 0 j + 130\, k$

$\Sigma f_x = 0$

$0.48\, F_A = 0.48\, F_B \qquad F_A = F_B$

$\Sigma f_y = 0$

$-0.28\, F_A - 0.28\, F_B + 0.55\, F_C = 0$

$-0.55\, F_B + 0.55\, F_C = 0$

$F_C = F_B = F_A$

$\Sigma f_z = 130$

$-0.83\, F_A - 0.83\, F_B - 0.83\, F_C = -130$

$3 F_A (-0.83) = -130$

$F_A = F_B = F_C = 52.21$ lb

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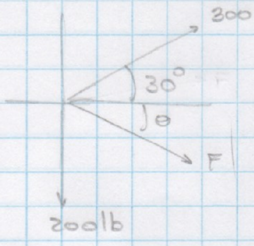
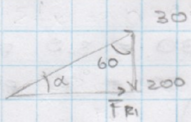
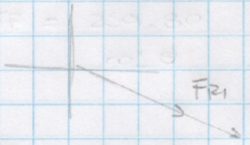
2 - 30





$F_{R1} = \sqrt{300^2 + 200^2 - 2(300)(200)\cos 60}$

$= 264.61$ lb



$F_T = F_{R1} + F$

$500 = 264.6 + F$

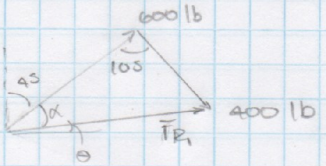
$F = 253.4$ lb ← mínima

$\theta = \alpha - 30$

$\theta = 10.1°$

$\frac{200}{\operatorname{sen}\alpha} = \frac{264.61}{\operatorname{sen} 60} \Rightarrow \alpha = 40.9$

2-31



$\bar{F}_{R_1} = \sqrt{600^2 + 400^2 - 800(600)\cos 105}$

$\bar{F}_{R_1} = 802.64$ lb

$\bar{F}_T = \bar{F}_{R_1} + \bar{F}$

$\bar{F} = 900 - 802.64 = 97.36$ lb

$\dfrac{400}{\text{sen}\,\alpha} = \dfrac{802.64}{\text{sen}\,105} \Rightarrow \alpha = 28.77$

$\theta = 45 - \alpha = 16.23°$

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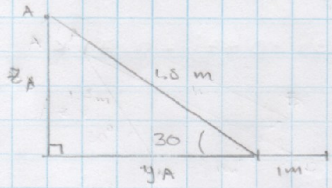
2-97



$y_A = 1.5 \cos 30 = 1.3$ m

$z_A = 1.5 \text{ sen } 30 = 0.75$ m

A (0, −2.3, −0.75)

B (0, 0, 0)

C (−2.5, −2.3, 0.75)

D (−0.5, 0, 0)

AB = (−0, +2.3, −0.75) $\quad |AB| = 2.42 \quad \hat{AB} = 0\hat{i} + 0.95\hat{j} - 0.31\hat{k}$

CD = (2, 2.3, −0.75) $\quad |CD| = 3.14 \quad AC = 0.64\hat{i} + 0.73\hat{j} - 2.24\hat{k}$

$\vec{F_A} = \bar{F}_A \cdot \hat{AB} = 300\,(0.95\hat{j} - 0.31\hat{k})$

$= 0\hat{i} + 285\hat{j} - 93\hat{k}$

$\vec{F_C} = \bar{F}_C \cdot \hat{CD} = 250\,(0.64\hat{i} + 0.73\hat{j} - 2.24\hat{k})$

$= (459\hat{i} + 183\hat{j} - 59.7\hat{k})$ N

2 - 104

A (0, 0, 24)

B (0, -10, 0)

C (16, 18, 0)

D (-12, 8, 0)

$\bar{F}_B = 520$ N
$F_C = 680$ N
$F_D = 560$ N

$AB = (0, -10, -24)$ $|AB| = 26$ $\hat{AB} = (-10j - 24k / 26)$

$\vec{F_B} = F_B \cdot \hat{AB} = 0i - 200j - 480k$

$AD = (-12, 8, -24)$ $|AD| = 28$ $\hat{AD} = (-12i + 8j - 24k / 28)$

$\vec{F_D} = F_D \cdot AD = -240i + 160j - 480k$

$AC = (16, 18, -24)$ $|AC| = 34$ $\hat{AC} = (16i + 18j - 24k / 34)$

$\vec{F_C} = F_C \cdot \hat{AC} = 320i + 360j - 480k$

$\bar{F}_R = \bar{F}_B + \bar{F}_C + \bar{F}_D = 80i + 320j - 1440k$

$|F_R| = 1447.3$ N

$\cos\alpha = \dfrac{F_{Rx}}{F_R}$ $\cos\beta = \dfrac{F_{Ry}}{F_R}$ $\cos\gamma = \dfrac{F_{Rz}}{F_R}$

$\alpha = 86.9°$ $\beta = 77.5°$ $\gamma = 167.1°$

2 - 106

A (3, -2, 0) E (0, 0, 6)

$EA = (3, -2, -6)$ $|EA| = 7$ $\hat{E}_A = \frac{3}{7}i - \frac{2}{7}j - \frac{6}{7}k$

$\vec{F_A} = F_A \cdot \hat{EA}$

$\bar{F}_R = 4\vec{F_A}$

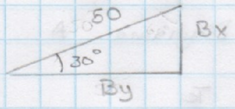
$-360k = 4[F_A(3/7i - 2/7j - 6/7k)]$

$-360k = -\frac{24}{7} F_A k$

$F_A = 105$ N portanto $F_A = F_B = F_C = F_D = 105$ N

2 - 110

A (0, 0, 35)



50 sen 30 = Bx = 25 pies

50 cos 30 = By = 43.30 pies

B (25, 43.30, 0)

$AB = (25, 43.30, -35)$ $|AB| = 61.03$

$\hat{AB} = \frac{25}{61.03} i + \frac{43.30}{61.03} j - \frac{35}{63.03} k$

$\vec{F} = F \cdot \hat{AB} = (143.37 + 248.32 - 200.72)$ lb

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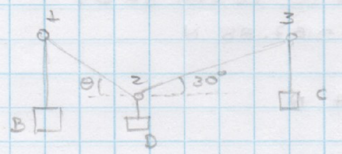
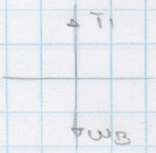
3 - 12



$W_B = 200$ lb $W_C = 100$ $W_D = ?$ $\theta = ?$

Diagrama 1

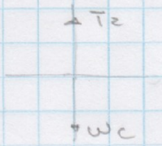


$\Sigma f = 0$

$T_1 = W_B$

$T_1 = 200$ lb

Diagrama 3

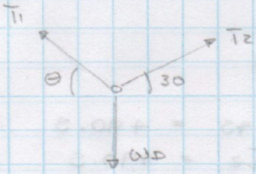


$\Sigma f = 0$

$T_2 = W_C$

$T_2 = 100$ lb

Diagrama 3



$\Sigma f = 0$

$\Sigma f_x = 0$

$T_2 \cos 30 = T_1 \cos \theta$

$\frac{100 \cos 30}{200} = \cos \theta \Rightarrow \theta = 64.34°$

$\Sigma f_y = 0$

$T_2 \text{ sen } 30 + T_1 \text{ sen } \theta = W_D$

$W_D = 100 \text{ sen } 30 + 200 \text{ sen } 64.34$

$W_D = 230.376$ lb

3 – 15

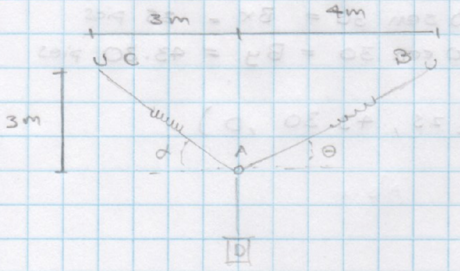
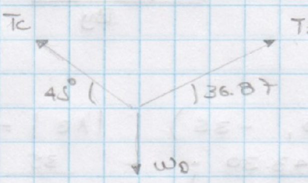
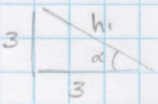


Diagrama A





$\alpha = \tan^{-1}\left(\frac{3}{3}\right)$

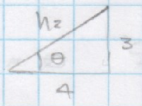
$\alpha = 45°$

$h_1 = \sqrt{18}$

$\sum f_y = 0$

$T_C \text{ sen } 45 + T_B \text{ sen } 36.87 = W_D$

$T_B = K_{AB} \cdot (5 - 3) = 60 \text{ N}$



$\theta = \tan^{-1}\left(\frac{3}{4}\right)$

$\theta = 36.87°$

$h_2 = 5$

$\sum f_x = 0$

$T_C \text{ sen } 45 = T_B \text{ sen } 36.87$

$T_C = 67.88 \text{ N}$

$w_D = 84 \text{ N}$

$m_D = w_D / g = 8.57 \text{ Kg}$

3 – 20

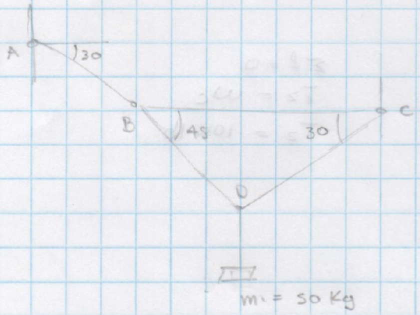
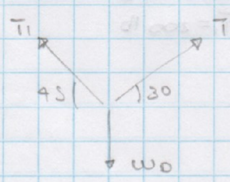


Diagrama D



$\sum f_x = 0$

$T_2 \cos 30 = T_1 \cos 45$

$T_1 = 1.22 \; T_2$

$T_1 = 456.80 \text{N}$

$\sum f_y = w_D = m_1 \cdot g$

$T_1 \text{ sen } 30 + T_2 \text{ sen } 45 = 490.5$

$0.61 \; T_2 + 0.70 \; T_2 = 490.5$

$T_2 = 374.43 \text{ N}$

Diagrama C

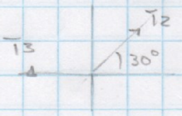
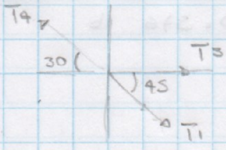


Diagrama B



$\sum f_x = 0$

$T_3 + T_1 \cos(-45) = T_4 \cos 150$

$T_4 = -747.4 \text{ N}$

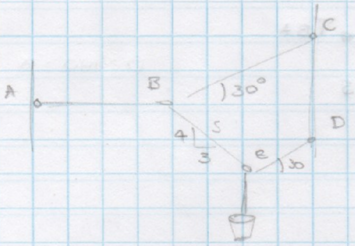
$\sum f_x = 0$

$T_3 = T_2 \cos 30$

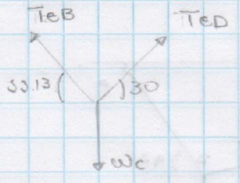
$T_3 = 324.26 \text{ N}$

$T_{AB} = T_4 = -747.4$ N
$T_{BC} = T_3 = 324.26$ N
$T_{BD} = T_1 = 456.8$ N
$T_{DC} = T_2 = 374.43$ N

3 - 25



DCL E



$\Sigma f_x = 0$

$T_{ED} \cos 30 = T_{EB} \cos 126.87$

$T_{ED} = \dfrac{T_{EB} \cos 126.87}{\cos 30}$

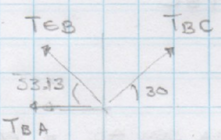
$\Sigma f_y = 0$

$T_{EB} \operatorname{sen} 126.87 + T_{ED} \operatorname{sen} 30 = W_c$

$T_{EB} \operatorname{sen} 126.87 + \dfrac{T_{EB} \cos 126.87}{\cos 30} \operatorname{sen} 30 = W_c$

$T_{EB} (\operatorname{sen} 126.87 + \cos 126.87 \cdot \tan 30) = W_c$

DCL B



$\Sigma f_y = 0$

$T_{EB} \operatorname{sen} 126.87 = - T_{BC} \operatorname{sen} 30$

$T_{BC} = - \dfrac{T_{EB} \operatorname{sen} 126.87}{\operatorname{sen} 30}$

$T_{BC} = - \left(\dfrac{W_c}{\operatorname{sen} 126.87 + \cos 126.87 \cdot \tan 30} \right) \left(\dfrac{\operatorname{sen} 126.87}{\operatorname{sen} 30} \right)$

$\Sigma f_x = 0$

$T_{BC} \cos 30 = T_{EB} \cos 126.87 + T_{BA}$

$T_{BA} = T_{BC} \cos 30 - T_{EB} \cos 126.87$

$T_{BA} = \left(- \dfrac{W_c}{\operatorname{sen} 126.87 + \cos 126.87 \cdot \tan 30} \right) \left(\cot 30 \cdot \operatorname{sen} 126.87 \right) - \left(\dfrac{W_c}{\operatorname{sen} 126.87 + \cos 126.87 \cdot \tan 30} \right) \cdot \cos 126.87$

$T_{BA} = - \dfrac{W_c}{\operatorname{sen} 126.87 + \cos 126.87 \cdot \tan 30} \left(\cot 30 \cdot \operatorname{sen} 126.87 + \cos 126.87 \right)$

$T_{EB} = 0.87\ W_c$

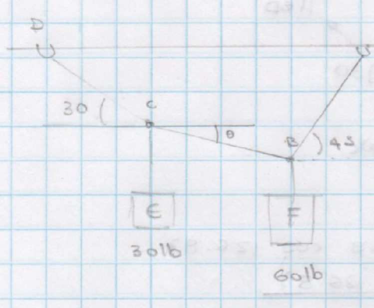
$T_{ED} = 0.6\ W_c$

$T_{BC} = 1.4\ W_c$

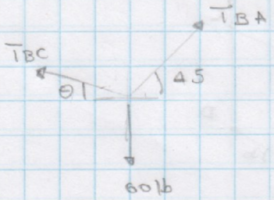
$T_{AB} = 1.74\ W_c$ => mayor

$W_c = \dfrac{T_{AB}}{1.74} = \dfrac{100}{1.74} = 57.47$ lb

3-26



DCL B



$\Sigma f_x = 0$

$T_{BA} \cos 45 = T_{BC} \cos\theta$

$\cos\theta = \dfrac{T_{BA} \cdot 0.7071}{T_{BC}}$

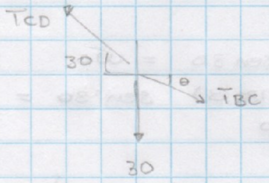
$\Sigma f_y = 0$

$T_{BC} \operatorname{sen} \alpha + T_{BA} \operatorname{sen} 45 = 60 \text{ lb}$

$T_{BC} \operatorname{sen}\theta + 0.7071\, T_{BA} = 60 \text{ lb}$

$\operatorname{sen}\theta = \dfrac{60 - 0.7071\, T_{BA}}{T_{BC}}$

DCL C



$\Sigma f_x = 0$

$T_{BC} \cos\theta = T_{CD} \cos 30$

$T_{BC} \left(\dfrac{T_{BA} \cdot 0.7071}{T_{BC}} \right) = T_{CD} \cos 30$

$T_{BA} = \dfrac{T_{CD} \cos 30}{0.7071}$

$\Sigma f_y = 0$

$T_{CD} \operatorname{sen} 30 = 30 + T_{BC} \operatorname{sen}\theta$

$\dfrac{T_{CD}}{2} = 30 + 60 - 0.7071\, T_{BA}$

$\dfrac{T_{CD}}{2} = 90 - T_{CD} \cdot \cos 30$

$T_{CD} = 65.7 \text{ lb}$

$T_{BA} = 80.8 \text{ lb}$

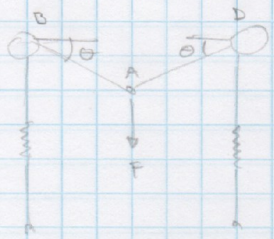
$\cos\theta = \dfrac{57.13}{T_{BC}}$ $\qquad$ $\operatorname{sen}\theta = \dfrac{2.86}{T_{BC}}$

$T_{BC} = \dfrac{57.13}{\cos\theta}$ $\qquad$ $57.13 \tan\theta = 2.86$

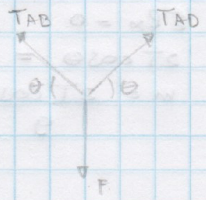
$\theta = 2.85°$

$T_{BC} = 57.16 \text{ lb}$

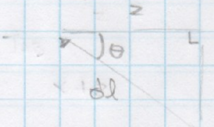
3-30



DCL A



$T_{AB} = K \cdot (dl - 2)$



$\cos\theta = \dfrac{2}{dl}$

$dl = \dfrac{2}{\cos\theta}$

$\Sigma f_x = 0$

$T_{AB} = T_{AD}$

$\Sigma f_y = 0$

$2 T_{AB} \operatorname{sen}\theta = F = 90$

$2K(dl - 2)\operatorname{sen}\theta = 90$

$2K\left(\dfrac{2}{\cos\theta} - 2\right)\operatorname{sen}\theta = 90$

$4K(\operatorname{tg}\theta - \operatorname{sen}\theta) = 90$

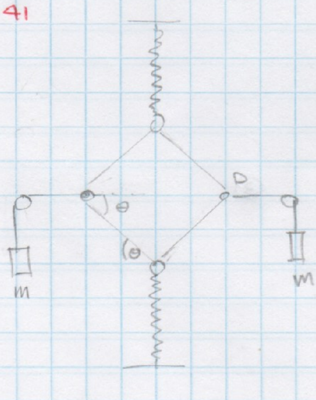
$4(\operatorname{tg}\theta - \operatorname{sen}\theta) = 3$

Por prueba y error

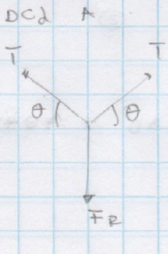
$\theta = 37.96°$

$T_{AB} = 33.09$ lb

3-41



DCL A



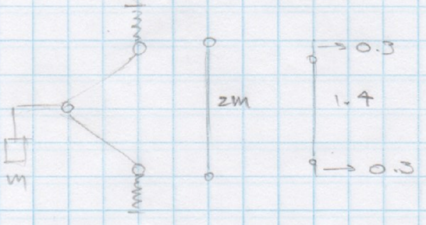
$\Sigma f_y = 0$

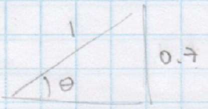
$2T \operatorname{sen}\theta = F_R$

$2T \operatorname{sen}\theta = 500 \cdot 0.3$

$2T \operatorname{sen}\theta = 150$

$T = \dfrac{75}{\operatorname{sen}\theta}$



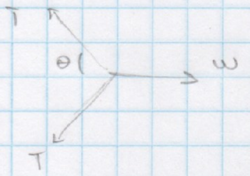


$\operatorname{sen}\theta = \dfrac{0.7}{1}$

$\theta = 44.4°$

$T = 107.1$ N

DCL D



$\Sigma F_x = 0$

$2T\cos\theta = W$

$m = \dfrac{2T\cos\theta}{g} = 15.6\ Kg$

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3-52

$m = 8\ Mg \ \dfrac{1000\ Kg}{1\ Mg} = 8000\ Kg$

$w = m.g = 78480\ N$

$T_{AB} = T_{AB}\left(\dfrac{2i - 1.25j - 3K}{3.82}\right) = 0.523T_{AB}\,i - 0.33T_{AB}\,j - 0.79T_{AB}\,K$

$T_{AC} = T_{AC}\left(\dfrac{2i + 1.25j - 3K}{3.82}\right) = 0.523T_{AC}\,i + 0.33T_{AC}\,j - 0.79\,T_{AC}\,K$

$T_{AD} = T_{AD}\left(\dfrac{-i - 3K}{3.16}\right) = -0.32\,T_{AD}\,i - 0.95\,T_{AD}\,K$

$\Sigma F_x = 0$

$0.523\,T_{AB} + 0.523\,T_{AC} - 0.32\,T_{AD} = 0$ ①

$\Sigma F_y = 0$

$-0.33\,T_{AB} + 0.33\,T_{AC} = 0$ ②

$\Sigma F_z = 0$

$-0.79\,T_{AB} - 0.79\,T_{AC} - 0.95\,T_{AD} + 78480 = 0$ ③

Resolviendo

$T_{AD} = 54500\ N$

$T_{AC} = T_{AB} = 16895\ N$

3-53

$T_{AB} = T_{AB}\left(\dfrac{-3j - 2.5k}{3.9}\right) = -0.77\,T_{AB}\,j - 0.64\,T_{AB}\,k$

$w = mg = 500 \cdot 9.81$

$w = 4905\ N$

$T_{AC} = T_{AC}\left(\dfrac{0.75i - 5j - 2.5k}{5.64}\right) = 0.133\,T_{AC}\,i - 0.89\,T_{AC}\,j - 0.443\,T_{AC}\,k$

$T_{AD} = T_{AD}\left(\dfrac{-1.25i - 5j - 2.5}{5.73}\right) = -0.22\,T_{AD}\,i - 0.873\,T_{AD}\,j - 0.44\,T_{AD}\,k$

$\Sigma f_x = 0$

$0.133\,T_{AC} - 0.22\,T_{AD} = 0$ ①

$\Sigma f_y = 0$

$-0.77\,T_{AB} - 0.98\,T_{AC} - 0.873\,T_{AD} = 0$ ②

$\Sigma f_z = 0$

$-0.64\,T_{AB} - 0.443\,T_{AC} - 0.44\,T_{AD} = 4905$ ③

Resolviendo

$T_{AD} = 6370.13\ N$ $\qquad T_{AD\,x} = 1401.43\ N$

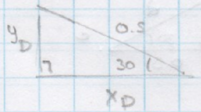
$T_{AB} = -19365.2\ N$ $\qquad T_{AB\,x} = 0\ N$

$T_{AC} = 10510.7$ $\qquad T_{AC\,x} = 1397\ N$

3-65

$w = mg = 981\ N = 0.981\ kN$

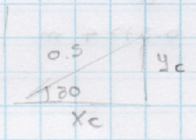
(AD)



$\cos 30 = \dfrac{x_D}{0.5}$ $\qquad \operatorname{sen} 30 = \dfrac{y_D}{0.5}$

$x_D = 0.433\ m$ $\qquad y_D = 0.25\ m$

(AC)



$x_c = 0.43 m$ $\qquad y_c = 0.25\ m$

$T_{AB} = 1kN\left(\dfrac{0.5j + zk}{\sqrt{0.25 + z^2}}\right)$

$T_{AC} = 1kN\left(\dfrac{-0.433i - 0.25j + zk}{\sqrt{0.25 + z^2}}\right)$

$T_{AD} = 1kN\left(\dfrac{0.433i - 0.25j + zk}{\sqrt{0.25 + z^2}}\right)$

$\Sigma f_x = 0$

$$\frac{-0.433}{\sqrt{0.25+z^2}} + \frac{0.433}{\sqrt{0.25+z^2}} = 0$$

$\Sigma f_y = 0$

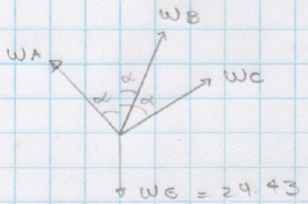
$$\frac{0.5}{\sqrt{0.25+z^2}} - \frac{0.25}{\sqrt{0.25+z^2}} - \frac{0.25}{\sqrt{0.25+z^2}}$$

$\Sigma f_z = 0$

$$\frac{1}{\sqrt{0.25+z^2}} + \frac{1}{\sqrt{0.25+z^2}} + \frac{1}{\sqrt{0.25+z^2}} = 0.981$$

$$\frac{3}{0.981} = \sqrt{0.25+z^2} \quad - \; z = 0.17\ m = 170\ mm$$

3 - 68



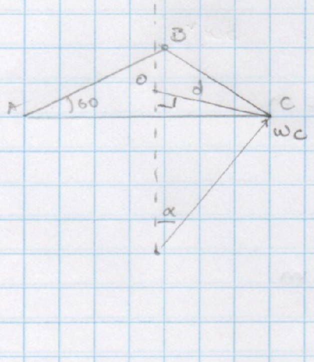
$W_A = W_B = W_C = 19.62$ N

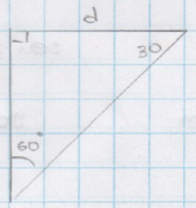
$\Sigma f_z = 0$

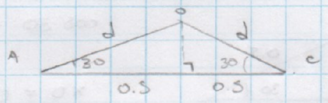
$3 W_A \cos\alpha = W_G$

$3\,(19.62)\cos\alpha = 29.43$

$\alpha = 60°$







$\tan 60 = \dfrac{0.5774}{s}$

$s = 0.3334$ m

$\cos 30 = \dfrac{0.5}{d}$

$d = 0.5774$ m